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Final Report of the AFIT Quality Initiative External Discovery Committee

Air Force Institute of Technology

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FINAL REPORT OF THE AFIT QUALITY INITIATIVE EXTERNAL DISCOVERY COMMITTEE

TECHNICAL REPORT

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DEPARTMENT OF THE AIR FORCE
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Wright-Patterson Air Force Base, Ohio

Executive Summary

This report summarizes the findings of the Air Force Institute of Technology's (AFIT's) Quality Initiative - External Discovery Team. The overarching purpose of the Quality Initiative is to create a detailed, executable investment strategy for modernizing AFIT's instructional capabilities. The Quality Initiative focused on five thrust areas:

1) Classroom and teaching laboratory design, functionality and utilization
2) E-learning technologies for resident and distance delivery
3) Faculty and Staff development programs and support infrastructure
4) Infrastructure to support advanced instructional technology capabilities
5) Organizational structures, policies, processes, procedures, and strategic vision to support effective teaching

The goal of the External Discovery Team was to reach out to academic institutions, corporate and government organizations, technology vendors, and other entities to identify ways that AFIT can improve instructional capabilities across each of the five thrust areas. The committee was composed of the following members, with focus areas as noted:

- Committee Chair - Maj Jason Bindewald, ENG, Assistant Professor
- Classroom Design - Mr. Rick Kappel – CEC, Instructor of Eng. Applications
- E-Learning Technologies - Maj Jason Freels – ENV, Assistant Professor
- Faculty Development - Dr. Betsy Grimes – EN, Director of Faculty Development & LtCol Andrew Geyer – ENC, Assistant Professor
- Infrastructure - Mr. Michael Hill – ENG, Division Laboratory Chief
- Organizational Structures - Ms. Amy High – ENW, Chief of Reader Services
- Member at Large: - Dr. Larry Merkle – ENG, Assistant Professor

Data collection activities included site visits (Buffalo Pacific, University of Cincinnati, University of Dayton, Wright State University, Ohio State University, Florida Institute of Technology), phone interviews (Harvard University, Murray State University, Case Western Reserve University, Gettysburg College, University of Central Florida), conference attendance (EDUCause, Educational Advances in Artificial Intelligence, IEEE Special Interest Group on Computer Science Education), journal publications related to teaching, and gathering of information through email requests and visiting publicly available websites.

These activities were completed over the course of one year, beginning in June of 2016 and concluding in June of 2017. The data gathered were evaluated and several recommendations for further review were decided upon by the External Discovery Team. The following report briefly covers those recommendations and provides sources from which the recommendations were gleaned.

The recommendations herein are meant to serve as a baseline for ways in which AFIT could begin to program resources to help improve teaching and instruction across the institution as a whole. Following is a summarized list of all recommendations of the External Discovery Team, organized by thrust area.

No cost or effort estimates are attached to the recommendations, due to uncertainty in what an implementation of any of the recommendations would look like. Most of the recommendations could range immensely in cost and ease of implementation dependent upon the scope of the ultimate project assumed. As such, cost and effort estimation is left to the AFIT Quality Initiative Gap Analysis and Investment Strategy team. The data presented here are meant to serve as a compliment to the Internal Discovery Team's report that focuses on data and feedback gathered from institutions internal to AFIT. These two reports combined, serve as a baseline for implementing an institutional instructional capability investment strategy.

Maj Jason M. Bindewald, Ph.D.
External Discovery Committee Chair

Thrust Area 1: Classroom Design

Classroom design is focused on the elements of teaching that support good teaching practices. A classroom should be able to be adjusted to best fit the needs of each class, and not the other way around. Many studies have found that students learn more effectively in active learning environments that utilize collaborative technologies [1]. The QIP External Discovery Committee is making design recommendations that promote an active/collaborative learning classroom and flexibility.

This section explores four capabilities that enhance learning. (1) Mobile tablet computer carts could be used to enhance the resources available to students during a course. (2) Displays with the capabilities to share student work with the class, teacher, or individual students support collaboration. (3) Furniture designed to be easily moved would make instructor room set-up adjustable to different pedagogies. (4) Interactive projectors enable instructors to manipulate and demonstrate course content directly to student observers.

I. Mobile tablet computer carts for students

Mobile tablet carts are used in many education environments. Each student is assigned a tablet, which has preloaded information or access to software or a website (ex. Blackboard). Students use the tablets during the course to take notes on the presentation, access spreadsheets, web pages, AFI's, etc. Students can save the course information electronically, which saves them office space and saves AFIT paper/printing costs.

I.A. Examples from Outside Organizations

The State of Ohio created Straight A Fund Grants to "launch creative new ideas for improving education." [2] Two local schools, Beavercreek and Kettering, used their funding to purchase computers or tablets for each student in their school system. Each student received a tablet or computer, depending on grade level, and used the cart and tablets therein during school for classwork and after school for homework. The ability for students to utilize this technology in the classroom enabled the use of many excellent outside resources. These technologies have also been used to increase collaborative learning between students:

- *eSpark Learning* in Beavercreek City Schools [3]
- Kettering City Schools [4]

Air Education and Training Command recently purchased 312 tablets for use in its DoD Fire Academy [5] courses as a mobile interaction learning environment. These tablets are being used in the classroom for collaborative exercises, teacher led projects, research, and assessment. Students are also able to take the tablets out in the field and conduct demonstrations. Annually, the Fire Academy is estimated to save $126K in O&M, $325K printing costs, and 7,042 reams of paper.

I.B Pros and Cons

The biggest cases for support in using mobile tablets in the classroom are the opportunities for students to access outside resources and collaborate with each other inside and outside the classroom.

The biggest con to adopting computer carts is the high initial up-front cost ($17,000) for a cart of 30 tablets. However, there are offsetting monetary savings in printing and paper costs to consider. The maintenance and upkeep of the cart and tablets should also be considered in this proposal.

II. Displays with click to share capabilities

Click to share capabilities involve a small hockey puck like device that plugs into a USB port of a tablet or computer. The computer user can click the puck and have his/her screen shared to display or projector. Displays equipped with sharing capabilities allow students to share their ideas and work with other students, the group, or the entire class. This ability to share is the corner stone of any active learning/collaborative environment.

II.A. Examples from Outside Organizations

Wright State University has designed classrooms that are specifically focused on employing active learning principles [6]. These classrooms employ a variety of mediums that can be shared with group or station displays or the main projector.

II.B Pros and Cons

A pro about the displays is that they are relatively cheap ($1,500) and are easily equipped with sharing technologies. A con would be the classroom space that they take up when not in use.

III. Small subset of classrooms designed with collaborative furniture setups

Collaborative furniture is flexible, easily moved, and can be designed to promote student centered learning. Many classroom arrangements are rigid and hard to reconfigure. Students will also need the ability to plug in computers and tablets. Collaborative furniture allows the instructor to design the classroom layout around the needs of the course. Classrooms equipped with collaborative furniture allows teachers to teach to their own pedagogy.

III.A. Examples from Outside Organizations

The Wright Brothers Institute has a mission of providing resources for AFRL research partners to come up with innovative solutions to problems [7]. Their rooms feature collaborative furniture and allow the user to easily set the room up however they choose. During a tour of the facility, committee members saw five different classrooms set up in five completely different ways.

III.B Pros and Cons

The biggest pro is the ability to organize a room around a class and promote collaboration. The biggest con is the high costs associated with the furniture and the room modifications needed to install the furniture (ex. electrical upgrades).

IV. Interactive projectors/display screens

Interactive projectors are commonly found in many classrooms around the US. The capabilities of an interactive projector allow the instructor to effectively manipulate web sites and course content. These projectors allow the teacher to teach in ways that weren't possible before. Products such as the Epson BrightLink® enable users to utilize an existing whiteboard without a screen [8].

IV.A. Examples from Outside Organizations

Every organization the external discovery committee visited utilized interactive projectors in one way or another. Examples of an organization making full use of the projector capabilities can be found at Kettering City Schools. Teachers use the projectors to access student assignments and demonstrations, show animations, dissect data on charts and graphs, and conduct virtual dissections.

IV.B Pros and Cons

A pro of interactive projectors is that they engage the audience in presentations beyond the normal limits of classroom instructions. However, a potential drawback to these systems is that they require training and reassessment of course material in order for faculty members to effectively utilize them.

Thrust Area 2: E-Learning Technologies

The phrase "e-learning technology" describes technology-based products used to manage educational content. In this context, content management can refer to any of the following capability areas

1. Infrastructure for storing, cataloging, and accessing content
2. Methods for capturing, sharing, presenting, and deploying content
3. Processes to integrate content – either between individuals, between e-learning technologies, or both

Although many examples of hardware-based e-learning technologies exist, most are delivered as online services via cloud-based software applications. When compared to the use of hardware tools, cloud-based delivery can lower the costs associated with providing e-learning services. However, cloud-based delivery has also accelerated the pace at which e-learning technologies become obsolete and replaced by newer technologies. As result, the number of e-learning technologies often increases rapidly as companies work to quickly develop tools to fill various educational needs. This rapid expansion in the number of e-learning tools is often followed by an equally rapid period of contraction due to either market forces or corporate acquisitions.

Due to these expansion/contraction cycles, the process of selecting an e-learning service can be difficult, as it involves identifying which features are important today while simultaneously trying to predict which features will be important in the future as newer services are made available with improved features. Therefore, the recommendations that follow are focused on implementing the 'must have' e-learning technologies as identified during on-site visits to universities by QIP external subcommittee. These recommended technologies include: (1) tools for cloud-based file sharing and collaboration, (2) tools for channeled communication, (3) tools for accessing, sharing, and re-using video content, and (4) interactive video distance learning. Note that several e-learning tools have recently been developed to deliver capabilities (3) and (4) as part of a single service. As result, recommendations (3) and (4) have been merged in the discussion below.

I. Tools for Cloud-based File Sharing and Collaboration

Cloud based file sharing (CBFS) is a service wherein individuals, with appropriate permissions, can access, edit, upload, or download files. CBFS facilitates easier collaboration on documents and presentations as the files can remain in a single location that can be accessed from anywhere in the world. Many CBFS services also help maintain version control for files and allow many users to edit documents simultaneously.

The QIP external committee asked the representatives from each school with whom we met "If you were forced to give up all but one e-learning technology – which would you keep". Each school responded that their CBFS service was the most important e-learning technology. A common response was that not having a CBFS service would have a significant negative effect on the ability of their faculty to collaborate both internally and with other institutions.

I.A. Examples from Outside Organizations

The most commonly used tools of this type are: Dropbox Business [9], Box Enterprise [10], OneDrive for Business [11], and Google Drive [12]. Examples of universities using these tools are listed below, and many universities (private and public) offer more than one of these tools. Finally, as Dropbox Business is a newer offering, relatively few examples of universities using this service are available. As result, Dropbox Business is not included in the list below.

- **Box Enterprise** – Ohio State, Miami (FL), Indiana, Illinois, Stanford, Cincinnati, Texas-Austin
- **OneDrive for Business** – Miami (FL), Auburn, Alabama-Birmingham, Wright State, Texas Tech, Harvard, UMASS
- **Google Drive** – Michigan, Western Michigan, Miami (FL), Syracuse, Minnesota, Dayton, Texas A&M, Harvard, MIT

From discussions with representatives at each school visited by the QIP external subcommittee, the choice of CBFS service providers was determined primarily by the answers to two questions:

1. Which service's security features are sufficient for our institution's needs?
2. How well will the service integrate with our LMS or other tools we already provide?

I.B. Pros and Cons

Pros to implementing a CBFS include better collaboration between faculty and distance students, continued collaboration with students who have already graduated, and easier access to files while traveling (sending web links to files instead of file paths on a local shared drive that often can't be accessed when not in the office). Cons include hurdles to obtaining authority to operate a system of this nature on a DoD network and ensuring that safeguards are in place to protect sensitive documents.

II. Tools to Organize Communications

Many organizations have adopted tools that aggregate, or channel, communication activities around 'teams'. In this context of AFIT, a team might be the entire organization, a department, a research group, a committee, or simply a group of individuals collaborating to reach some decision. Channeled communication has become very popular because it allows users to focus on their most important communication channels. By contrast, email consolidates all communication in an inbox, forcing users to respond to every notification to determine if it is important.

Channeled communication tools can also be configured such that certain communication channels constrain activity to within an organization while other channels allow members from outside organizations. Further, many channeled communication tools integrate with other tools and services to provide a richer functionality. For example, faculty can quickly discover who has expertise in a certain research area and then invite them to join a channel focused on discussing efforts in that area. As another example, many channeled communication tools can integrate with Office 365 such that team members can create and collaborate on Office documents in real time. Finally, channeled communications can help leadership emphasize certain stories and events to specific teams.

II.A. Examples from Outside Organizations

The most commonly used tools of this type are: Slack [13], Microsoft Teams [14], Zoom [15], Google+ [16], and Skype for Business [17]. Examples of universities using these tools are listed below. Note that (1) Microsoft Teams is a new offering and has not yet been approved for use in the MS Office Suite used by government organizations; therefore, it is not included in the list, and (2) Google+ is available as a subscription service for individuals and for organizations. However organization subscriptions only come with a subscription to G Suite. As AFIT has chosen to use Canvas as its LMS, and not G Suite, Google+ is not included on the list of tools below.

- **Slack –** Harvard
- **Zoom** – Harvard, Michigan State, Kansas State, Notre Dame, Georgetown, Rutgers, Tennessee, Arkansas, Houston, Xavier, Austin Peay, Rice, Santa Clara, Stanford
- **Skype** – Indiana, Illinois, Purdue, Pittsburgh, Arkansas, Tennessee, Marquette, South Florida, Boston, Rochester, Buffalo, Edinburgh, Colorado-Denver, Wright-State, Stirling

II.B. Pros and Cons

Pros to organized communication software include integrating voice, text, video, images, and files into every communication stream; archiving and searching communications (by channel or across many channels); customizing notification settings for any communication channel: ability to turn off notifications for noisy channels and keep them on for others; and many providers offer tools to make any room capable of hosting a VTC or recording a lecture. Cons can include an emergent litany of communication "channels" to organize; ensuring security communications and integrations could be a lengthy process; and training AFIT faculty & staff to use a new communication paradigm could be challenging.

III. Tools to access, edit, and re-use existing video content

As a body, the AFIT faculty have created a large volume of video content for teaching various topics to both in-resident and non-resident students. When instructors develop new courses, or update existing ones, having access to existing video content could make the process faster. Tools have been developed for storing and cataloging video content so that it can be easily accessed and utilized by many instructors across multiple courses. As example, many AFIT courses include math content presented by ENC as part of the refresher videos provided to new students. Having an accessible repository of video content could reduce the amount of time spent revamping courses.

Several products exist to make the process of creating, uploading, editing, and cataloging video content much easier. Some of these products can be used to construct overlays to the videos, making them interactive. For example, allowing students to make persistent annotations directly on the video such that instructors and students can review previous comments. Finally, many of these products provide dashboards presenting data analytics on which students have viewed an assigned video, the points within the video where students spent the most time, and any comments the students had about ideas that they found to be confusing.

III.A. Examples from Outside Organizations

The most commonly used tools of this type are: Sharestream [18], Panopto [19], Mediasite [20], and Kaltura [21]. Examples of universities using these tools are listed below.

- **Sharestream –** Georgetown, Iowa, Eastern Washington, Texas A&M, Maryland, North Florida, Lewis University, Tulane, Georgia State
- **Panopto** – Kettering, Michigan, Ohio University, Utah, LSU, Auburn, Rochester, Texas A&M, Washington, Emory, Cornell, Yale, Johns Hopkins, USC, George Washington, Illinois, Virginia, Virginia Tech, Miami, Boston College, Baylor, Akron, Oregon, Brown, Pepperdine**,** Arizona, Tennessee, BYU, Hong Kong, Stanford, Oxford, Columbia, Iowa, Cal-Berkley, Minnesota State, NYU, William & Mary
- **Mediasite** – California State University System (23 Campuses), Ohio State, Northwestern, Arizona State, Clarion University, Duke, Villanova, Syracuse, Houston, Colorado, Carnegie-Mellon
- **Kaltura** – Alaska, Georgia Southern, Oregon State, Illinois, Miami, UCONN

III.B. Pros and Cons

Pros to using video indexing tools include integration with closed captioning services; dashboards providing insight to see which videos students watch, how long they watch, and when they stop watching; and creating an easily accessible campus video portal or "AFIT YouTube." Cons include products that require videos to be uploaded to external servers (removing control from AFIT support); access to videos is dependent on network reliability for certain products; and security of content once it is posted.

Thrust Area 3: Faculty Development

The External Discovery Team compared the information on faculty development best practices, current programming and activities, and successful initiatives at a variety of institutions. This data enabled the committee to compare faculty development programs of various sizes and compositions. The result of this analysis was a set of common characteristics across institutions that present opportunities for AFIT to create a contemporary faculty development program that is consistent with other successful programs. The following recommendations have been demonstrated to be beneficial to the faculty, the institution, and ultimately the students and appear to be feasible with current levels of available support.

These items are based on best practices and programming at the institutions examined by the External Discovery Team. While there is considerable diversity among the various institutions based on size, mission, and student population, the following items are found consistently. The recommendations are: (1) A Center for Teaching and Learning that can be used by faculty and students from all AFIT schools; (2) Revised new faculty orientation program for the Graduate School of Engineering; (3) Organized opportunity for faculty members from all schools to engage with leadership; and, (4) A Faculty Advisory Committee composed of representatives from each school.

I. Center for Teaching and Learning

A teaching and learning center at AFIT could be housed centrally and contain the faculty development function as well as various services that support teaching and learning excellence. Such services could include: access to the library resources and reference personnel; course designers (a common feature at OSU, University of Cincinnati, Wright State University and University of Dayton) and e-learning technology and support (AFIT Extension Services); and, technical writing assistance (the technical writer position). If space permits, such a center could also provide small group meeting space for students, and technology equipped classroom space available by request of faculty members.

These facilities house various services for both faculty and students including faculty development, course designers, e-learning support and instruction, tutoring, writing support, and often library research or other library services. Teaching and learning centers typically serve both faculty and students and often house innovative classroom space utilizing alternative design to facilitate the use of technology and active learning environments. The recommendations in areas of e-technology, classroom design, and infrastructure would coincide with the development of a center for teaching and learning.

I.A. Examples from Outside Organizations

Such centers were found at the committee's visits to Ohio State *University Center for the Advancement of Teaching* [22], University of Cincinnati *UC Center for the Enhancement of Teaching and Learning* [23], Wright State University *The Center for Teaching and Learning* [24], and University of Dayton, *Ryan C. Harris Learning Teaching Center* [25]. Teaching and learning centers were also reported at the institutions interviewed by phone, including Air University,

Teaching and Learning Center. Additional examples are easily available online as well: University of Minnesota *Center for Educational Innovation* [26], Colorado School of Mines *Trefny Innovative Instruction Center* [27], and Middlebury *Center for Teaching, Learning, & Research* [28].

The centers were titled differently at each institution and the configuration of services was somewhat different depending on the mission, resources, and priorities of each. However, the purpose and intent was reflected across all of the institutions and teaching and learning centers appear to be quickly becoming a standard feature on campuses. This phenomenon reflects a new understanding of how learning best occurs, the needs and expectations of students, and the growing influence and opportunity presented by e-learning technology in the classroom.

I.B. Pros and Cons

The benefits to AFIT would include a comprehensive facility to support teaching effectiveness and innovation, student learning through ready availability of support services and resources, and ease of access to all services housed in the center. The central location would also encourage the use of existing resources such as educational technology, and encourage faculty and students to maximize resources to the benefit of all constituents. The center would also coincide with the QIP recommendations for infrastructure and classroom design, and developing the center could provide benefits to all three areas. Such a facility would also more closely align AFIT with other institutions in the area and the United States, especially those with strong technology and science programs. There are associated costs, however; the primary concern is the location of the center, as a physical space would need to be assigned with possible costs for remodeling, upgrading, or rewiring.

II. Examine and Revise the New Faculty Orientation Program

Another common feature among many institutions in the comparison group was a mentoring program. These were either in place or in planning stages at the time of the Team's inquiry. Mentoring programs take multiple forms but the most common appear to be for junior faculty [29] or special groups of faculty members such as women [30] or for newly appointed chairs, as in a program at The Ohio State University. Mentors provide information, support, guidance and enculturation for the individuals receiving mentoring in an effort to improve retention, morale, and performance of the target group. A mentoring program could be included in the new faculty orientation where senior faculty mentors would be paired with new faculty in their respective departments.

II.A. Examples from Outside Organizations

Example programs were found in several locations throughout the committee's search, such as the one at Wright State University [31], Murray State University's *New Faculty Academy* [32], and Northern Illinois University's *New Faculty Mentoring Program* [33]. While AFIT has offered a new faculty orientation program in the past, the content could be revised to include vital information to support success in the crucial first year and improve retention, performance, and job satisfaction among new faculty.

II.B. Pros and Cons

The benefits of a redesigned new faculty orientation would include: new faculty better equipped to develop and manage their classrooms; faculty with improved understanding of the culture and expectations of AFIT; streamlined orientation programming with inclusion of the most critical information; and finally, new faculty that are better prepared for productivity in the first year. The program will, however, take two weeks of the faculty member's time and in order to be beneficial, the content of the orientation must be carefully planned and executed. The effectiveness of the presentations and the speakers included in the agenda is an important element that cannot be minimized. These individuals must be selected with care and forethought and presented with outcome expectations for their component of the orientation in order that the full benefit be realized.

III. Recurring Engagement of Faculty with Leadership

Opportunities to interact with senior administration having direct knowledge of and responsibility for academic issues is another common feature of the faculty development programs of the universities interviewed. These gatherings often take the form of informal meetings in small group settings with a dean in a "coffee and conversation" or brown bag setting. Such meetings give faculty an opportunity to ask questions and feel that their voice is heard. In some cases is it figuratively and literally "a place at the table" meant to enlighten, empower, and inform both the faculty member and the administrator. The recommendation is to initiate a monthly "brown bag" lunch meeting with the Dean to enable a small group of faculty to interact. Every faculty member would receive an invitation to attend during the academic year.

III.A. Examples from Outside Organizations

For example, the Dean of the College of Engineering at Harvard University meets with junior faculty on a regular basis in support of their professional development, teaching, and research [34]. A similar process was observed at The Ohio State University on a site visit, where junior faculty were regularly invited to meet with school and university leaders. Other examples include Brown Bag Town Hall meetings with the President and provost at Stanford University [35] and collaborative lunch meetings at Allegheny College [36].

III.B. Pros and Cons

Benefits of this proposal would include a greater sense of investment in the overall institution and a sense of importance for the contribution of each individual faculty member. The cost includes the time invested by each faculty member in the meeting and the cost to the administrator for his/her time. Also, there is a time and energy investment to schedule, plan, send invitations, and track these meetings and participation rates.

IV. Develop a Faculty Development Advisory Committee

A faculty development advisory board or committee is another element frequently incorporated into faculty development programs. These boards provide information regarding faculty needs, new ideas to grow and develop programs, assistance with informing faculty of opportunities

available through the faculty development program, and general support for personnel and programs. As Sorcinelli [37] states, “Faculty development programs should never remain static. They must adjust creatively and responsively to meet changing student, faculty, institutional, and societal needs. They, like professors, can never be finished products” (p. 8).

Faculty development programming within the institutions examined is typically provided on a regular basis and attempts to provide information that appeals to a broad segment of the faculty. Programs may be brief lunch hour presentations introducing a new idea for teaching, using technology, self-care, student advising, etc. (such programming is provided, for example, at University of Central Florida and Wright State University). These brief programs are often supplemented by less frequent more formal opportunities to examine a topic in greater depth and for a longer period of time, as was seen at University of Cincinnati. A faculty development advisory committee would ideally include representation from each school within AFIT to insure that all faculty and instructors within the organization are aware of and provided access to professional development opportunities and have input into programming.

IV.A. Examples from Outside Organizations

Examples of this practice were seen during committee site visits to the University of Cincinnati and Wright State University, as well as during an interview with University of Central Florida. Several other examples can be found throughout academia, such as the Wake Forest School of Medicine [38] and Fayetteville State University [39].

IV.B. Pros and Cons

Such a committee would provide valuable input from the departments through the representatives on the council to enable tailoring of the training and development offerings of the faculty development program. The limitation would lie in finding representatives from each school and department that recognized the benefit of participation and was willing to devote time to attending meetings of the committee and dissemination information in his/her department and/or school.

Thrust Area 4: Infrastructure

The information gained about infrastructure can cross into laboratory, classroom and multimedia setups, but is focused on the codified set of minimum requirements for upgrades of physical structures. This would include upgrades to the facilities, such as basic classroom infrastructure, assessment of buildings/classrooms, classroom furniture, and building studies.

Infrastructure can overlap into classroom/design and learning centers for students and faculty. There are different forms of infrastructure; physical structure, IT hardware/software, and furniture. The three recommendations from the external discovery committee pertaining to infrastructure include (1) a codified set of minimum requirements for facilities upgrades, (2) clear understanding of how funding can be raised and used for facilities upgrades, and (3) a clear/centralized scheduling function for both classrooms and equipment.

I. Codified Set of Minimum Requirements for Facilities Upgrades

All classrooms and common areas such as coffee bar area, lobbies outside of classrooms, etc. should support multi IT drops, power consumption, classroom IT equipment, etc. when redesigned to support classrooms, faculty/students. Student by today's standards usually have at least three internet capable devices; cell phone, laptop, and notepad on them at all times while in a university and/or college environment. Students want the capability to type up reports (laptop) while still having separate access to taking/making calls (cellphone) while referring to notes taken in class (tablet). Other areas of requirements should also be looked at such a power consumption, new projectors, classroom furniture, etc.

I.A. Examples from Outside Organizations

Wright State University has a newly built learning center that is dedicated to meeting the needs of students by ensuring there is support of up to five IT devices per student at any given time. All classrooms and common areas such as the learning center have been and/or are in the process of being upgraded when funding is available to accommodate a minimum of three networked devices per student, accommodating both power and internet access.

The Ohio State University has "Policies and Procedures" and "Design Guidelines for Buildings and landscaping" to help make sound fiscal decisions [40]. University of Cincinnati has "Use of Facilities Policy Manual" to guide faculty to make clear concise decisions on classroom design [41]. Additionally, Science magazine has an online article on adding efficiency to general lab equipment [42].

I.B. Pros and Cons

The upgrade of multiple device parts and wireless network capability is suggested. Providing a minimum number of IT connections per student would increase their productivity through review of notes, writing up research documents, while being able to make and take calls from fellow students or advisors, all without having to drop a connection. The negative impact to adding more IT drops and/or capabilities for some number of connections per student would be the cost of increasing internet bandwidth to support the number of total devices being used, including

classroom IT devices. Other negative impacts would be initial cost, timeline to complete and a support team to keep the system up and running.

II. Establish Clear Understanding of How Money May Be Raised and Used for Facilities Upgrades

Currently, funds to upgrade buildings contain restrictions based on DoD and federal guidelines. For example, research monies obtained by faculty members, are allowed to make small modifications such as upgrading classrooms, upgrading power from single-phase to two- or three-phase and upgrading power requirements for equipment per manufacturer specifications. A reference cheat sheet is recommended in order to clearly communicate how money can be used in accordance with policies and guidelines. Once policy is decided, training and a tool check sheet should be implemented.

II.A. Examples from Outside Organizations

The Ohio State University raises all new building funds and building support is furnished by monies brought in by the provost, grants, and donations from OSU alumni and/or supporters. Facilities infrastructure and furniture are evaluated and replaced on a seven year life cycle while information technology equipment is evaluated and replaced every three years.

The University of Cincinnati (UC) receives funding from the federal government for both direct and indirect cost of associational university research. Indirect cost are those that fall into the category of Facilities and Administration cost to include expenditures such as electricity, heating, and air conditioning [43]. UC funding policy for financing for construction projects is owned by the Senior Vice President for Administration and Finance with responsibility given to the vice president for Finance Controller for Planning + Design + Construction.

II.B. Pros and Cons

A better understanding of these processes would allow faculty to focus on bringing in the right types and amounts of research funds and to expend said funding more effectively once it arrives. Cons to this process would be a lack of clear guidance on how to actually executive facilities upgrades due to an unclear set of processes and policies which must be followed for DoD, AFIT, and Federal guidance.

III. Clear and Centralized Scheduling Functions for Both Classrooms and Equipment at the Highest Feasible Level

Implementation of a central hub for all scheduling of classrooms and equipment not necessarily tied to a classroom is recommended. This type of scheduling module would allow for users to see details about the classroom or equipment, such as seating capacity and availability and allow for use across all schools. The process would provide a central point of contact to schedule all classrooms, and common laboratories to accommodate the faculty and student requirements for classes, minor laboratory reviews and group study. By doing so, we could increase our use of space, and equipment, thus increase how efficiently we operate. A central hub for scheduling could allow for fewer conflicts and wasted time to physically look for open space or usage time of

equipment. The schedule should be available to view on a website and/or SharePoint site by as many people as possible.

III.A. Examples from Outside Organizations

Several examples of this type of process exist, such as at The University of Maryland [44], Miami University (Ohio) [45], and The University of Oklahoma [46].

III.B. Pros and Cons

A centralized scheduling function at the highest feasible level could improve utilization of space throughout the campus, and gives faculty and students the latest information on room availability. Metrics can be established to determine usages of rooms to maximize use of space and cost should be based on software used (Outlook Calendar already in place; no cost), and time to setup the schedule. Cons include that taking control of conference rooms to be assigned from current departments to use for all, will increase the scheduler's workload slightly, but should be a lesser negative impact after implementation. This tool would also require the identification of a primary organization to handle the maintenance of the tool's accuracy.

Thrust Area 5: Organizational Structures

Organizational structures are the hierarchy of units within an organization. One of the main questions that the committee wanted to explore through our research and visits was how do organizational structures support effective teaching. The recommendations below examine evaluation practices, hiring policies and new ways of sharing knowledge, research, and resources that improve the learning environment for faculty and students. Large projects such as the multidisciplinary initiatives discussed below are overseen by the universities' provost offices. Administrative offices establish general guidelines on tenure, program reviews and evaluations. At many schools these guidelines are customized within the department or college by faculty and departments heads. Collaboration and communication among the different levels of organizational structures is a key part of their successes.

Recommended organizational structure findings for AFIT to consider include: (1) mandatory peer to peer evaluation of teaching; (2) distinguished external reviewers of academic programs; (3) codifying professor of practice positions; (4) establishing both teaching and research tenure tracks; (5) increased inter-departmental education; and (6) rethinking the functionality of the library.

I. Peer to Peer Evaluation of Teaching

Peer to peer evaluation of teaching provides faculty with an avenue of feedback that identifies their strengths and weaknesses in teaching. There are two types of peer to peer evaluations. Formative peer evaluations are done to help faculty improve their teaching skills. Summative peer evaluations are often done before tenure or promotion reviews to assess the quality of the faculty member's teaching abilities. The summative peer to peer evaluations fall under organizational structures because it is often an integral part of the tenure process. However formative peer evaluations could also fall under faculty development as these evaluations help faculty improve on their skills and feedback from their peers could be considered a form of mentoring.

I.A. Examples from Outside Institutions

University of Texas at Austin provides excellent guidelines and resources for implementing a peer review system that can be both formative and summative [47]. They promote implementation and customization of a peer review system at the departmental level. "Creating a system for peer review is not simply adopting a checklist, tool, instrument, or technique that others have devised. We envision departments constructing a customized tool for ongoing development that builds on what its instructors know and need to support their own as well as their students' learning." The University of Oregon also has helpful guidelines [48] and Penn State also offers peer review guidelines specifically for online teaching [49].

Wright State and University of Dayton both offer programs that involve peer to peer evaluation on a formative level. Wright State's Center for Teaching and Learning offers mid-term evaluation visits from other faculty who observe them in the classroom. On these visits, the students are surveyed and the faculty reviewer offers feedback to the faculty member being visited. Through the UD Learning Teaching Center, faculty can request a Midterm Instructional Diagnosis [50] facilitated by a faculty member from another department. This faculty member visits the class,

breaks students into groups and gives them three questions to answer about the class. The students are then brought back together as a group with the facilitator to discuss their answers and provide feedback. The faculty facilitator then meets with the instructor to provide the student feedback and their own observations on the class dynamics. The diagnosis is confidential and only shared if the faculty member decides to share it. Both programs provide faculty with the opportunity to make changes to their classes if needed while it still benefits the students, and in many cases, improve their end of semester evaluations.

Summative peer-to-peer evaluations are often an integral part of the tenure process. At the University of Dayton's College of Art and Sciences their guidelines require that "final recommendations regarding tenure must be based upon at least two peer reviews of classroom teaching and of course materials, conducted during at least two different semesters." At Ohio State, Kay Wolf, Vice President for Academic Policy and Faculty Resources, highlighted the OSU Department of Veterinary BioSciences tenure guidelines. Depending on the teaching load, their department suggests that faculty have one or more summative peer reviews a year. The peer reviews should be initiated by the faculty member but can be initiated by the department chair if the faculty member has had low marks on their evaluations. For the peer evaluations, the faculty member and reviewer are required to meet ahead of time to discuss the faculty's course goals, teaching style and philosophy and to get copies of their syllabus and other class materials. After the meeting and class observations, the reviewer provides a summative report that goes to the faculty member evaluated and the department chairperson. It is suggested that copies of the report also go in their annual review and dossier. In an examination of other schools, peer evaluation varied depending on the faculty status. Non-tenured faculty have yearly peer reviews. Tenure track faculty peer reviews were dependent on where they were in the tenure process. Tenured faculty peer reviews were less frequent unless there were issues with their teaching.

I.B. Pros and Cons

Instituting a peer to peer evaluation system would take some time to develop initially, but there are several schools that provide helpful guidelines that could be adaptable to AFIT. A decision would need to be made to either develop one new process across EN departments, have each EN department be responsible for developing their own system, or a hybrid with some guidelines across departments and some customized by each department. Since the evaluation is in house no additional costs would be involved. One aspect to consider, however, is whether AFIT dynamics would affect peer to peer review. Can a military faculty of a lower rank, review faculty with a higher rank? Could civilian faculty be reviewed by a military faculty that is not tenured? Criteria for selecting the peer reviewer would be important.

II. External Reviewers for Academic Program Reviews

Academic Program Reviews are a key component of an academic department's success. They identify a department's strengths and weaknesses. Departments can use the feedback delivered to make immediate changes and develop guidelines for continuous improvement. Some universities require external reviewers to be a part of the process. External reviewers are individuals outside the university who are considered experts in their fields and whose knowledge "provide insight

and feedback on issues and trends particular to the discipline." The reports they produce "serve as a constructive base for future improvement; they are intended to be a catalyst for the unit to chart and seek change."

II.A. Examples from Outside Institutions

Using external reviewers for program reviews was introduced to the committee at the Ohio State visit by Dr. Randy Smith, Vice Provost for Academic Programs. He discussed their academic program review [51] process which includes a self-study by the department being reviewed and an external review. Their review included an extensive list of questions to consider for both the self-study and external review. Among the questions that the external reviewers examine are:

- Does the department have a research foci?
- Does the department continue to do things the same way?
- What majors are popular and what classes do students stumble through?
- How does the department keep new faculty?
- What are the role of inclusion, mentoring and department chairs?

The external review team meets with school and department administration, tenured and non-tenured faculty, students and representatives from research centers associated with the department. The final step in the review is developing a plan of action based on the self-study and external review recommendations. The plan of action identifies immediate and continuous improvements.

Smith also recommended looking at the Northwestern University program review process [52] which is very similar. One difference is that after their self-study, Northwestern assigns internal reviewers to work with the external reviewers in a liaison capacity. The Northwestern review process is also overseen by a Program Review Council made up of appointed senior faculty and administrators that have served as internal reviewers. Cornell offers effective tips to help faculty within a department prepare for the external reviews [53].

II.B. Pros and Cons

Including external reviewers in the academic program review process would be a great asset to AFIT. They could provide valuable feedback from a different perspective. They could ensure that AFIT programs and courses are relevant and rigorous. An external review also allows AFIT to highlight their own research to prominent individuals in their fields of study. Time and planning would be required to incorporate external reviewers into the current program review cycle. Cost could also be a factor in bringing the external reviewer or reviewers to AFIT. It would need to be determined if external reviewers could be funded the same way as HLC and ABET visits are funded.

III. Professor of Practice Positions

Professors of Practice bring practical, real life experiences to the classroom and provide students with experiential learning opportunities. Peer institutions such as NJIT, Ohio State, Cornell, Columbia University, Georgia Tech, RPI and Virginia Tech have all established professor of practice positions. Cornell defines Professor of Practice as a "title reserved for individuals whose

experiences in industry, or other non-academic organizations, complement the tenure-track and non-tenure-track faculty in the college. The typical holder of this title is an experienced leader from an upper managerial, technical or research position in his or her organization. These individuals are expected to enrich the experience of students by bringing a deep understanding and appreciation of the best practices as applied in real-world settings" [54].

III.A. Examples from Outside Organizations

UC San Diego provides detailed guidelines for departments implementing a professor of practice program [55]. General guidelines are similar, but certain criteria vary among universities. Many of the universities require professors of practice to have licenses or certificates and at least 10 years of experience in their field. At some universities Professors of Practice are non-tenure-track employees, but at others they could seek tenure status. For promotion at Ohio State, one Professor of Practice position required "professional practice and service activities that emphasize outreach" for promotion consideration. The University of Dayton hires local leaders in business, the arts and engineering to teach courses but call them clinical faculty not Professors of Practice. In addition to Professors of Practice positions, the University of Cincinnati's engineering, aerospace and business departments have industry advisory boards made up of industry leaders that collaborate with the departments on internship programs, curriculum and research.

Establishing Professor of Practice positions at AFIT would be very beneficial to student learning and foster research connections and collaborations. The Miami Valley has businesses and industries that reflect AFIT's research interests in aerospace, cyber and logistics. Having the Professors of Practice in house would provide AFIT with connections to local companies that work with the military and other businesses. Professors of Practice could enhance student's knowledge through their real world experiences and provide them with opportunities to actually visit businesses and industries in their areas of study. AFIT students could use their knowledge and research to collaborate with these businesses to solve real-world problems.

III.B. Pros and Cons

Positives of implementing Professor of Practice positions would include the ability to bring in subject matter experts to teach classes as applicable, specifically allowing AFIT to take advantage of distinct advantages that AFIT's active duty military pool of professors can provide significant work experience. Time and funding would be major considerations in establishing a Professor of Practice position at AFIT. One factor would be the amount of time it takes to get new positions classified and approved. Another would be in deciding what type of appointment this would be in relation to Air Force guidelines. For example would the position be an over-hire, adjunct, civilian or contractor? The appointment would help in determining what funding would be available for the position.

IV. Tenure Tracks for Both Teaching and Research Faculty

During the research of and visits to different universities, the committee examined whether tenure tracks were available for both teaching faculty and research faculty. At most of the universities visited, teaching was one of three factors of tenure evaluation as well as service and

research/scholarship. However, few had separate tracks just for teaching. How much each factor influenced the tenure review varied among the schools. These variances were due to reflection on the university's mission, departmental preferences, and faculty input.

IV.A. Examples from Outside Organizations

At the University of Cincinnati, tenure track faculty have two tracks: a research track and an educator track. Each track has separate criteria. The educator track has a higher course load (6-8 classes per year vs 2-3 courses per year) with less emphasis on research. This enables UC to develop faculty that specialize, increasing the effectiveness of both research and teaching efforts.

Gettysburg College has instituted a system to balance faculty commitments between research, service and teaching wherein faculty get to choose what percentage of their appraisal goes to each area. This allows faculty to have more freedom in pursing tenure in a non-traditional way. At UD faculty are also required to show strengths in teaching, research and service, but the emphasis on one over the other varies among the academic departments. At Ohio State an increased emphasis is being put on teaching to reflect the university mission's core goals. However, OSU recognizes differences between departments. "In evaluating the candidate's qualifications in teaching, scholarship, and service, reasonable flexibility shall be exercised, balancing, where the case requires, heavier commitments and responsibilities in one area against lighter commitments and responsibilities in another" [56]. The Social Work department, for example, puts a heavier emphasis on teaching while at the College of Medicine national recognition has a big impact.

Case Western is also very research intensive. The departments vary in what they require, but medicine and engineering stress the research component, specifically funded research in the tenure process. Excellence in teaching is also expected but comes in second after research. Any service requirements are kept very minimal before tenure. They want faculty to focus on their research/scholarship and teaching. "To Tenure and Beyond" is a program open to nominated second-year, tenure-track faculty. Those selected meet throughout the year [57].

IV.B. Pros and Cons

Pros to this approach include the ability to balance a faculty that rotates continuously due to the tempo of Air Force and DoD movement of faculty members, thus allowing faculty to focus more on the things they are interested in during their time here. Cons could include becoming imbalanced toward teaching or research at the expense of the other at a school level, wherein measures would be needed to keep proper balance.

V. Processes to Create Flexibility in Allowing Education across Departments

All of the universities that the committee visited have recently completed or are in the process of updating their strategic plans. In line with their plans, many of them have started new hiring initiatives and/or put an emphasis on interdisciplinary research. In some cases faculty are hired for newly created majors while others are brought in to work on a specific research area that crosses disciplines. This push towards interdisciplinary research attracts top faculty and provides students with the opportunity to work closely with a variety of faculty on innovative research projects.

V.A. Examples from Outside Organizations

UC's Cluster Hiring Initiative [58] is "designed to harness the power of faculty members in targeted areas in an attempt to help solve the world's biggest challenges through leading-edge research and interdisciplinary collaborations." Within UC's engineering departments a 50 in 5 initiative is underway to hire 50 new faculty in five years to work in a multidisciplinary environment. For example the Analytics Cluster is a collaboration of the Colleges of Education, Criminal Justice, Business, Engineering, Medicine and the UC libraries and IT department. Through the clusters, they hope to attract top researchers, faculty and funding.

Interdisciplinary research is also one component of Ohio State's Discovery Themes Initiative. "The Discovery Themes Initiative must be a model of interdisciplinarity and transinstitutionality that promotes and enhances broad university collaboration" [59]. Ohio State has nine focus areas of interdisciplinary research. They include Translational Data Analytics, Brain Injury and Materials and Manufacturing for Sustainability among others. Faculty in Translational Data Analytics come from a spectrum of departments including agriculture, decision sciences, sensors, genomics and history as well as computer science. Ohio State recently created the first data analytics major at a research university in the United States. Students will be working with the faculty involved in the Translational Data Analytics focus area.

Similar to programs at UC and Ohio State, Case Western University's engineering department has started its own strategic hiring initiative. It also crosses disciplines to include research areas such as Smart Energy, Sustainable Manufacturing and Biomedical Engineering. Under the hiring initiative, "Case Western Reserve is seeking senior, mid-level and junior faculty who are proven leaders in interdisciplinary research. The university also is making diversity a priority in this effort, to increase the proportion of women and underrepresented minorities among the engineering faculty. Successful candidates will hold primary appointments in the Case School of Engineering, although in many instances they will be eligible for secondary appointments, for example within the School of Medicine or College of Arts and Sciences."

In joint appointments at the University of Dayton [60] the primary department or research center must take primary responsibility for the faculty member. The appointment document must indicate the extent of the faculty member's responsibilities in the second unit and what percentage of their pay will come from this unit. These policies are similar to other schools with joint appointments [61]. Many joint appointment policies stress the importance of communication between the two departments in that share the faculty member [62]. Teacher workload, departmental voting rights, student advising and research funding are among the items that both departments must come to an agreement on when making their appointments.

V.B. Pros and Cons

Our research centers are a good example of interdisciplinary research that is already taking place at AFIT. Much of the research done has helped solve Air Force and Department of Defense challenges that reflect our mission and strategic plan. AFIT could possibly repackage the way we promote center research to show that AFIT is on par with interdisciplinary programs at other universities. Many other schools include both teaching along with research in their centers.

Leveraging AFIT's research centers to include degree programs could open up new opportunities to address DoD needs. One facet of interdisciplinary research that AFIT lacks is a process for acknowledging faculty that work across disciplines. Adapting a joint appointment policy with specific guidelines in place could attract more faculty to interdisciplinary work.

VI. Rethinking of Library Functionality and Librarian Responsibilities

With changes in technology and information retrieval, libraries are finding themselves at a crossroad. Librarians see their roles, teaching styles and their use of physical space in the library changing. They are challenging themselves to find new ways to reach out to students and other offices that complement their services.

VI.A. Examples from Outside Organizations

In three of the libraries that the committee visited, two had teaching and learning centers and labs located on a floor of the library. Wright State's Writing Center is in their Student Success Center but they hold hours in the library to better reach students. Universities libraries across the country have coordinated with their IT departments to upgrade their AV centers to digital media labs to offer students and faculty access to 3D printers, and an array of software and hardware for animation, web design and video, digital and sound editing projects. The Freedman Center for Digital Scholarship [63] at Case Western's Kelvin Library incorporates these features and offers fellowships for faculty. New students at Case Western also have a personal librarian assigned to them when they arrive who work with them throughout their first two years. The library initiated the project as a way to promote library services and assist in retention efforts of the university. At other universities, library liaisons are expanding their roles, working not only with academic departments but writing centers and other offices on campus. SOCHE's Library Workshop, New Partnerships for Academic Libraries: Transforming for New Times [64], in May highlights a variety of collaborative efforts between libraries and other academic offices at local universities.

VI.B. Pros and Cons

By implementing changes in the ways that librarians function in the AFIT academic environment, AFIT could leverage a changing work-force to move forward into a world where physical books are no longer the norm. Additionally, this would allow for AFIT to recapture vital physical space for other purposes. Cons include a possible tendency to minimize what the library at AFIT does well and to hinder their outstanding support by completely changing the scope in an unduly large manner.

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13. SUPPLEMENTARY NOTES

14. ABSTRACT

This report summarizes the findings of the Air Force Institute of Technology's (AFIT's) Quality Initiative - External Discovery Team. The overarching purpose of the Quality Initiative is to create a detailed, executable investment strategy for modernizing AFIT's instructional capabilities across five thrust areas. These activities were completed over the course of one year, beginning in June of 2016 and concluding in June of 2017. The data gathered were evaluated and several recommendations for further review were decided upon by the External Discovery Team. The following report briefly covers those recommendations and provides sources from which the recommendations were gleaned. These recommendations are meant to serve as a baseline for ways in which AFIT could begin to program resources to help improve teaching and instruction across the institution as a whole. The data presented here are meant to serve as a compliment to the Internal Discovery Team's report that focuses on data and feedback gathered from institutions internal to AFIT.

15. SUBJECT TERMS

Quality Initiative, Institutional Improvement, Instructional Capabilities, External Review

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